BIOE 447
DIGITAL DESIGN AND VISUALIZATION
Syllabus – Spring 2014

INSTRUCTOR

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office hours: By appointment

COURSE ADMINISTRATION

Course Objectives and Outcomes

Students will acquire basic to intermediate-level digital design proficiency for bioengineering-related applications. Individual work will reinforce best modeling practices using advanced visualization programs.

Course Objectives. Students should learn:

1. To use computer aided design programs to generate realistic models.
2. To reconstruct three-dimensional models from imaging data.
3. Effective visual communication through figures and drawings using best practices

Course Outcomes. Students completing this course will be able to:

1. Master the use of several computer aided design (CAD) packages, including TinkerCAD, IronCAD, and Rhinoceros 3D.
2. Apply best practice modeling techniques with these programs, beginning with the construction of virtual models, high quality renderings of your designs, and annotated 2D drawings.
3. Create dynamic virtual models using parametric modeling techniques in Grasshopper.
4. Convert imaging data files from their native format into three-dimensional models, including the reconstruction of volumes from medical scanning data (MRI, CT) of biological systems, surface scans acquired from a 3D scanner, and data corresponding to biological molecule geometries.
5. Use Adobe Photoshop, Illustrator, and InDesign to generate high quality graphics and document design work and process.

A number of additional skills and tools fall under the umbrella of digital design or visualization but are not taught in this course. Among them they are: animation techniques, Blender, 3D printing of parts or laser cutting.

Class Time and Location

Students are expected to be PROMPT (if not a few minutes early) to lab. Students are expected to stay until the end of the lab period. Each meeting will run for the ENTIRE DURATION of the laboratory time and is fully scheduled with content during this time. At least one brief break will occur each meeting based on energy level and natural flow of the content.

Class meets on Mondays and Wednesdays from 1:00 - 5:00 p.m., from 1/22 – 3/12.
On **Mondays** class will be held in the **OEDK Computer lab**.
On **Wednesdays** class will be held in the **Mudd Computer lab**.

Attendance Policy

Students are required to attend **ALL** sessions of the laboratory. Job interviews, medical school interviews, other classes, or extracurricular activities are not valid excuses. Because this lab involves active learning for the full meeting time and the content is cumulative it is impossible for you to "make up" any sessions. Therefore, you are STRONGLY DISCOURAGED from missing any sessions. Students choosing to miss a lab session to attend another commitment must speak with Dr. Wettergreen to discover a way to learn the content and complete the required assignments. Illness and family emergencies will be dealt with on an individual basis. Contact Dr. Wettergreen immediately as soon as an emergency arises.

Safety

This laboratory carries no safety requirements. Shorts, open-toed shoes and any glasses may be worn with impunity.

Honor Code Policy

Much of the learning in this lab comes from coaching and interaction with other students, the instructor, and the TAs. It is important that a collegial environment is present. For all exercises and homework each student will work on the assignments independently but are free to discuss strategies and best practices with all other students, Dr. Wettergreen and the T.A.

Teaching Assistants

The function and purpose of the TAs in this course are to ensure that everyone is both paying attention, caught up, and able to complete the content for each of the assignments. The TAs will be present at each meeting to interact with students and provide feedback and guidance. Learning digital design takes practice. Therefore, every weekend TAs will hold an afternoon-long session for those who require additional assistance for their homework or own learning.

TAs for Spring 2014:
Visualization: Ben Adler, baa3@rice.edu
Modeling: Ryan Rightmer, rrightmer@gmail.com
All-Around: John Cocjin, jbc6@rice.edu

Weekend TA Sessions: Sunday 1:00 PM – 5:00 PM (Tentative)

Table 1. BIOE 447 Schedule

Session	Programs Used	Topic	Date
1	TinkerCAD, IronCAD, Photoshop	Introduction to Computer Aided Design (CAD), CAD Operation	1/22
2	IronCAD, Photoshop	Basic modeling with IronCAD	1/27
3	IronCAD, Photoshop	Advanced modeling with IronCAD	1/29
4	IronCAD, Photoshop, Illustrator	Creating Technical Drawings of CAD Models	2/3
5	IronCAD, Photoshop, Illustrator, Excel, Matlab	Information Design and Visualization	2/5
6	Rhino, Photoshop, Illustrator	Basic modeling with Rhinoceros 3D (Rhino)	2/10
7	Rhino, Photoshop, Illustrator	Advanced modeling with Rhino	2/12
8	Rhino/ Grasshopper, Photoshop, Illustrator	Basic parametric modeling with Grasshopper	2/17
9	Rhino/Grasshopper, Photoshop, Illustrator	Advanced Parametric modeling with Rhino	2/19
11	Slicer, Photoshop, Illustrator	Basic Use of Slicer, Data Acquisition from Medical Imaging Modalities	2/24
12	Slicer	Independent Tutorials and Work	2/26
13	PrimeSense, Skanect, Rhino, Photoshop, Illustrator	Special Topics: Data Acquisition from 3D Scanning	3/10
14	Pymol, Chimera, Rhino, Photoshop, Illustrator	Special Topics: Data Acquisition from Other Sources	3/12
FINAL	Location: TBD, Time TBD		TBD

COURSE CONTENT

Class Activities and Support

Class time will be used in a variety of ways, including short lectures, active learning, individual work, partnered work, tutorials, and student oral presentations. Active listening and participation is ESSENTIAL at all points during this laboratory. The pace of the entire lab is dependent upon the

attention and progress of all members taking the lab.

Textbook and Digital Resources

There is no course pack or textbook for this laboratory. All pertinent content will be delivered in class so students will need to maximize the existing lab time to learn the technologies and practice them with the instructor and peers in attendance. Supplemental resources are available on Owlspace for each topic in the form of documentation, additional references, and tutorials.

Recommended Physical Resources

This course is completed exclusively in front of a shared lab or personal computer. Two physical resources that will make this course less of a hassle are a *wireless mouse* and a *large external hard drive*.

A quality computer mouse is as essential as a personal pen or pencil for adding comfort and speed to your work. Additionally, by bringing your own mouse to class you will not be subject to the style or quality of the lab computers.

This class generates LARGE files; sometimes in the GB range. Historically in the worst case scenarios this has crashed students' online file storage and wreaked havoc on their email systems. For that reason it is recommended that you have a portable solution for file storage that is less size constrained or dependent upon transfer speed.

Software Resources

All computers with an engineering build should have the necessary programs installed. This specifically includes Mudd Lab and the OEDK computers at the least.

There are additional programs that may be useful for you to install on your personal computers. Some are listed here:

- Gimp, photo editing program, free, (gimp.org)
- Slicer, medical imaging software, free, (slicer.org)
- Pymol, protein visualization software, free, (pymol.org)
- Chimera, molecule visualization software, free, (cgl.ucsf.edu/chimera/)
- Meshlab, mesh manipulation (CAD), free, (meshlab.sourceforge.net/)

ASSIGNMENTS and GRADING

BIOE 447 laboratory includes 10 graded assignments. Half of these assignments are "in-class." These assignments are designed to provide immediate feedback from peers and instructors on best modeling and visualization techniques. The other half of the assignments are more substantial and are to be completed outside of class. These assignments will extend your capabilities using these best modeling techniques and visualization skills. These assignments will constitute the majority of your grade.

Oral Critique

One of the major focuses for this course is to help you to develop an understanding and a vocabulary of the aesthetics of visual communication. To assist and speed this development, the first ten minutes of each meeting will be used to critique the previous homework assignment. This is an open session involving all of the members of the class, EXCEPT Dr. Wettergreen. The goal of this segment is to

provide a comfortable atmosphere to discuss best practices and critique each other's work for improvement. A participation grade will be awarded for this segment of the course.

Table 2. Calculation of Course Grade

Assignment	**% Final Grade**
Check Assignments (5 – 25 points each)	10
Take Home Assignments (4 – 25 points each)	40
Participation (25 points)	10
Final Project (100 points)	40

Individual Assignments

Each individual student will complete all of their own work both in and out of lab. Students are encouraged to seek help from the instructor, other students and talk about their assignments and best modeling techniques. Students are encouraged to give one another critical and helpful feedback regarding their modeling and visualization both in and out of class.

Advanced Tasks / Assignments

In some instances it may be the case that individual members or the class as a whole has mastered a topic and requires more advanced learning opportunities. In these situations the TAs or Dr. Wettergreen may create or modify an assignment to add extra points available as "extra credit." Extra credit problems may place additional constraints or restrictions on the problem solution, or may simply be larger in scope. These advanced assignments are not required except in the situation where the entire class has mastered a topic and requires more advanced learning.

Final Project

Your final project for this laboratory will combine all of the modeling programs used into one long tool chain. This project will be completed independently by each student. Documentation for this project will be in the form of a written document and a formal presentation delivered during the final exam period.

Table 3. Assignment Schedule

#	Assignment	Assigned	Due Date
1	Creating and Editing Image Renderings (In-Class, 5 points)	1/22	2/22
2	Advanced Solid Modeling (Take Home, 25 points) *Greatest cognitive difficulty for the entire semester	1/27	2/2 Midnight
3	Advanced CAD Modeling (In-Class, 5 points)	1/29	1/29
4	Technical Drawing (Take Home, 25 points)	2/3	2/9 Midnight
5	Senior Design Visualization (Take Home, 5 points)	2/5	2/16 Midnight
6	Modeling in Rhino (Caliper Lines) (In-Class, 5 points)	2/10	2/10
7	Polyhedra Tessellation with Rhino (Take Home, 25 points)	2/12	2/16 Midnight
8	Basic Grasshopper Assignment (In-Class, 5 points)	2/17	2/17
9	Grasshopper Latticing (Take Home, 25 points)	2/19	2/23 Midnight
10	Final Project (Take Home, 100 points)	2/24	3/18

Late Policy

If an assignment is turned in late, the grade will be reduced 10% per day.

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities should also contact Disability Support Services in the Allen Center.